

CLAIMS

1. In a computer environment including at least one data storage area and at least one backup data storage system coupled to the at least one data storage area, the at least one backup storage system configured to execute at least two backup processes in parallel to backup target data stored in the at least one storage area, each backup process to back up a respective portion of the target data, an apparatus comprising:
- at least one contention controller, coupled to the at least one backup storage system, that distributes the respective portions of the target data among the at least two backup processes based, at least in part, on an availability of at least one resource in the computer environment used by the at least one backup storage system to access the target data.
2. The apparatus of claim 1, wherein each backup process is capable of using the at least one resource, and wherein the at least one contention controller distributes the respective portions of the target data among the at least two backup processes so as to reduce a contention for the at least one resource between the at least two backup processes.
3. The apparatus of claim 2, wherein the at least one contention controller distributes the respective portions of the target data among the at least two backup processes based on at least one physical location of the respective portions of the target data in the at least one storage area.
4. The apparatus of claim 2, wherein the at least one contention controller distributes the respective portions of the target data among the at least two backup processes based on at least one of a physical location of the respective portions of the target data in the at least one storage area and at least one path between the at least one backup storage system and the physical locations of the respective portions of the target data.
5. The apparatus of claim 2, wherein the at least one resource includes at least one

storage medium in the at least one storage area on which the target data is stored, and wherein the at least one contention controller distributes the respective portions of the target data among the at least two backup processes to reduce contention for the at least one storage medium.

5

6. The apparatus of claim 5, wherein the at least one storage medium includes at least one disk drive, and wherein the at least one contention controller distributes the respective portions of the target data among the at least two backup processes to reduce contention for the at least one disk drive.

10

7. The apparatus of claim 2, wherein the at least one resource includes at least one access path controller, coupled to the at least one backup storage system, that controls at least one path between the at least one backup storage system and the target data, and wherein the at least one contention controller distributes the respective portions of the target data among the at least two backup processes to reduce contention for the at least one access path controller.

15

8. The apparatus of claim 2, wherein the at least one contention controller assigns the respective portions to the at least two backup processes such that each respective portion includes approximately a same amount of target data.

20

9. The apparatus of claim 2, wherein the at least two backup processes include N backup processes, and wherein the at least one contention controller pre-assigns a first portion of the target data to a first backup process of the N backup processes, wherein the first portion is to be backed up during a first time period when the N backup processes are executed, and wherein the at least one contention controller makes at least one comparison of contention for at least one first resource used to access the first portion between the first backup process and at least one other backup process of the N backup processes during the first time period, and generates at least one contention penalty for the first backup process based on the at least one comparison.

25

30

10. The apparatus of claim 9, wherein the at least one contention controller makes

the at least one comparison of the contention for the at least one first resource used to access the first portion between the first backup process and at least one other backup process of the N backup processes during a comparison time period that includes at least one guard band time period added to the first time period.

5

11. The apparatus of claim 9, wherein after the at least one contention controller generates the at least one contention penalty for the first backup process, the at least one contention controller further pre-assigns the first portion to a second backup process of the N backup processes, the at least one contention controller making at least one
10 comparison of contention for the at least one first resource used to access the first portion between the second backup process and at least one other backup process of the N backup processes during the first time period and generating at least one contention penalty for the second backup process based on the at least one comparison.

12. The apparatus of claim 11, wherein the at least one contention controller assigns the first portion of the target data to a particular one of the first backup process and the second backup process having the lowest at least one contention penalty.

13. The apparatus of claim 11, wherein the at least one contention controller further
20 consecutively pre-assigns the first portion to each remaining backup process of the N backup processes until at least one contention penalty is generated for each backup process of the N backup processes.

14. The apparatus of claim 13, wherein the at least one contention controller assigns
25 the first portion to a particular backup process of the N backup processes having the lowest at least one contention penalty.

15. The apparatus of claim 13, wherein the at least one contention controller assigns the first portion to a particular backup process of the N backup processes based on at
30 least one of the at least one contention penalty for each backup process and an amount of the target data already assigned to each backup process.

16. The apparatus of claim 15, wherein the at least one contention controller makes a second comparison of a first elapsed time of each backup process having the lowest at least one contention penalty and a second elapsed time of a shortest backup process of the N backup processes, the at least one contention controller assigning the first portion to the particular backup process based, at least in part, on the second comparison.

17. The apparatus of claim 16, wherein the at least one first resource includes a plurality of resources, and wherein the at least one contention controller prioritizes the plurality of resources differently.

10

18. The apparatus of claim 15, wherein the at least one contention controller pre-assigns each respective portion of the target data to each backup process of the N backup processes to generate at least one contention penalty for each respective portion in each respective process, and assigns each respective portion to a respective particular backup process of the N backup processes based on at least one of the at least one contention penalty for each respective portion in each backup process and an amount of data already assigned to each backup process.

19. The apparatus of claim 2, in combination with the at least one backup storage system and the at least one storage area.

20

20. In a computer environment including at least one data storage area and at least one backup data storage system coupled to the at least one data storage area, the at least one backup storage system configured to execute at least two backup processes in parallel to backup target data stored in the at least one storage area, each backup process to back up a respective portion of the target data, an apparatus comprising:

25

means, coupled to the at least one backup storage system, for distributing the respective portions of the target data among the at least two backup processes based, at least in part, on an availability of at least one resource in the computer environment used by the at least one backup storage system to access the target data.

30

21. In a computer environment including at least one data storage area and at least

one backup data storage system coupled to the at least one data storage area, the at least one backup storage system configured to execute at least two backup processes in parallel to backup target data stored in the at least one storage area, each backup process to back up a respective portion of the target data, a method comprising an act of:

- 5 a) distributing the respective portions of the target data among the at least two backup processes based, at least in part, on an availability of at least one resource in the computer environment used by the at least one backup storage system to access the target data.

- 10 22. The method of claim 21, wherein the act a) includes an act of distributing the respective portions of the target data among the at least two backup processes based on the availability of the at least one resource at different times during the at least two backup processes.

- 15 23. The method of claim 21, wherein the act a) includes an act of distributing the respective portions of the target data among the at least two backup processes based on at least one physical storage location of the target data.

- 20 24. The method of claim 21, wherein the act a) includes an act of:
 b) distributing the respective portions of the target data among the at least two backup processes to reduce contention for at least one path between the at least one backup storage system and the target data.

- 25 25. The method of claim 21, wherein each backup process of the at least two backup processes is capable of using the at least one resource to backup its respective portion of the target data, and wherein the act a) includes an act of:

- b) assigning respective portions of the target data to the at least two backup processes so as to reduce a contention for the at least one resource between the at least two backup processes.

30

26. The method of claim 25, wherein the act b) includes an act of assigning the

respective portions to the at least two backup processes such that each respective portion includes approximately a same amount of the target data.

27. The method of claim 21, wherein the at least two backup processes include N backup processes, and wherein the act a) includes acts of:

b) pre-assigning a first portion of the target data to a first backup process of the N backup processes, the first portion to be backed up during a first time period when the N backup processes are executed;

c) making at least one comparison of contention for at least one first resource used to access the first portion between the first backup process and at least one other backup process of the N backup processes during the first time period; and

d) generating at least one contention penalty for the first backup process based on the at least one comparison.

28. The method of claim 27, wherein the act c) includes an act of making the at least one comparison of the contention for the at least one first resource used to access the first portion between the first backup process and at least one other backup process of the N backup processes during a comparison time period that includes at least one guard band time period added to the first time period.

29. The method of claim 27, further including acts of:

e) pre-assigning the first portion to a second backup process of the N backup processes;

f) making at least one comparison of contention for the at least one first resource used to access the first portion between the second backup process and at least one other backup process of the N backup processes during the first time period; and

g) generating at least one contention penalty for the second backup process based on the at least one comparison.

30. The method of claim 29, further including an act of:

h) assigning the first portion of the target data to a particular one of the first backup process and the second backup process having the lowest at least one contention penalty.

5 31. The method of claim 29, further including acts of:

h) pre-assigning the first portion to another backup process of the N backup processes;

i) making at least one comparison of contention for the at least one first resource used to access the first portion between the other backup process and at least one backup
10 process different from the other backup process during the first time period;

j) generating at least one contention penalty for the other backup process based on the at least one comparison; and

k) repeating acts h), i), and j) until at least one contention penalty is generated for each backup process of the N backup processes.

15

32. The method of claim 31, further including an act of:

l) assigning the first portion to a particular backup process of the N backup processes having the lowest at least one contention penalty.

20 33. The method of claim 31, further including an act of:

l) assigning the first portion to a particular backup process of the N backup processes based which of the N backup processes have the lowest at least one contention penalty and an amount of data already assigned to each of the N backup processes.

25 34. The method of claim 33, wherein the at least one first resource includes a plurality of resources, and wherein the method further includes an act of:

k) differently prioritizing the plurality of resources.

35. A computer readable medium encoded with a program for execution on a
30 computer in a computer environment including at least one data storage area and at least one backup data storage system coupled to the at least one data storage area, the at least one backup storage system configured to execute at least two backup processes in

parallel to backup target data stored in the at least one storage area, each backup process to back up a respective portion of the target data, the program, when executed on the computer, performing a method comprising an act of:

- 5 a) distributing the respective portions of the target data among the at least two backup processes based, at least in part, on an availability of at least one resource in the computer environment used by the at least one backup storage system to access the target data.

36. The computer readable medium of claim 35, wherein the act a) includes an act of
10 distributing the respective portions of the target data among the at least two backup processes based on the availability of the at least one resource at different times during the at least two backup processes.

37. The computer readable medium of claim 35, wherein the act a) includes an act of
15 distributing the respective portions of the target data among the at least two backup processes based on at least one physical storage location of the target data.

38. The computer readable medium of claim 35, wherein the act a) includes an act of:
b) distributing the respective portions of the target data among the at least two
20 backup processes to reduce contention for at least one path between the at least one backup storage system and the target data.

39. The computer readable medium of claim 35, wherein each backup process of the at least two backup processes is capable of using the at least one resource to backup its
25 respective portion of the target data, and wherein the act a) includes an act of:

b) assigning respective portions of the target data to the at least two backup processes so as to reduce a resource contention among the at least two backup processes.

40. The computer readable medium of claim 39, wherein the act b) includes an act of
30 assigning the respective portions to the at least two backup processes such that each respective portion includes approximately a same amount of the target data.

41. The computer readable medium of claim 35, wherein the at least two backup processes include N backup processes, and wherein the act a) includes acts of:

- b) pre-assigning a first portion of the target data to a first backup process of the N backup processes, the first portion to be backed up during a first time period when the N backup processes are executed;
- c) making at least one comparison of contention for at least one first resource used to access the first portion between the first backup process and at least one other backup process of the N backup processes during the first time period; and
- d) generating at least one contention penalty for the first backup process based on the at least one comparison.

42. The computer readable medium of claim 41, wherein the act c) includes an act of making the at least one comparison of the contention for the at least one first resource used to access the first portion between the first backup process and at least one other backup process of the N backup processes during a comparison time period that includes at least one guard band time period added to the first time period.

43. The computer readable medium of claim 41, wherein the method further includes acts of:

- e) pre-assigning the first portion to a second backup process of the N backup processes;
- f) making at least one comparison of contention for the at least one first resource used to access the first portion between the second backup process and at least one other backup process of the N backup processes during the first time period; and
- g) generating at least one contention penalty for the second backup process based on the at least one comparison.

44. The computer readable medium of claim 43, wherein the method further includes an act of:

h) assigning the first portion of the target data to a particular one of the first backup process and the second backup process having the lowest at least one contention penalty.

5 45. The computer readable medium of claim 43, wherein the method further includes acts of:

h) pre-assigning the first portion to another backup process of the N backup processes;

i) making at least one comparison of contention for the at least one first resource used to access the first portion between the other backup process and at least one backup process different from the other backup process during the first time period;

j) generating at least one contention penalty for the other backup process based on the at least one comparison; and

k) repeating acts h), i), and j) until at least one contention penalty is generated for each backup process of the N backup processes.

46. The computer readable medium of claim 45, wherein the method further includes an act of:

l) assigning the first portion to a particular backup process of the N backup processes having the lowest at least one contention penalty.

47. The computer readable medium of claim 45, wherein the method further includes an act of:

m) assigning the first portion to a particular backup process of the N backup processes based on at least one of the at least one contention penalty for each backup process and an amount of data already assigned to each backup process.

48. The computer readable medium of claim 47, wherein the at least one first resource includes a plurality of resources, and wherein the method further includes an act of:

n) differently prioritizing the plurality of resources.